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ESOPHAGEAL REPLACEMENT FOR END-STAGE BENIGN ESOPHAGEAL DISEASE

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Background: **Benign esophageal diseases constitute a common group of disorders that are generally managed with medical therapy or surgery designed to improve foregut function. A small subset of patients, however, has advanced disease that requires esophageal replacement to achieve symptomatic relief.** ***Patients and methods:*** **One hundred four patients with benign esophageal disease who underwent esophageal reconstruction over a 21-year period (1975 to 1996) were reviewed retrospectively. Dysphagia was the major symptom driving surgery in 80% of the patients. Colon was used to reconstruct the esophagus in 85 patients; stomach, in 10 patients; and jejunum, in 9 patients. Forty-two patients who had lived with their reconstruction for 1 year or more answered a postoperative questionnaire concerning their long-term functional outcome.** ***Results:*** **In the 104 patients, the primary underlying abnormality leading to esophageal replacement was end-stage gastroesophageal reflux (37 patients), an advanced motility disorder (37 patients), traumatic, iatrogenic or spontaneous perforation (15 patients), corrosive injury (8 patients), congenital abnormality (6 patients), or extensive leiomyoma (1 patient). Ninety-eight percent of patients reported that the operation had cured or improved the symptom driving surgery. Ninety-three percent were satisfied with the outcome of the operation. The overall hospital mortality rate was 2%, and the median hospital stay was 17 days. Graft necrosis occurred in 3% of patients, and anastomotic leak occurred in 6% of patients (or 2% of the total number of anastomoses).** ***Conclusions:*** **Esophageal replacement for benign disease can**

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be accomplished with a low mortality rate and a marked improvement in alimentation. Reconstruction restores the pleasure of eating and is viewed by the patient to be highly successful. (J Thorac Cardiovasc Surg 1998;115: 1241-9)

Benign esophageal diseases constitute some of the most common disorders affecting the gastrointestinal tract. In most cases, the symptoms experienced by patients with esophageal disease are minor, intermittent, and easily controllable with medications or lifestyle modifications. A subset of patients with more advanced disease may be referred for surgical therapy designed to improve foregut function or to correct anatomic abnormalities. There remains a group of patients, however, with end-stage esophageal disease in whom the magnitude of esophageal dysfunction is such that esophageal resection with replacement remains the only alternative.

This study reports a 21-year experience with esophageal replacement for end-stage, benign disease, with a specific focus on the conditions that lead to esophageal replacement, the effectiveness of relieving the primary symptom driving the replacement, the morbidity and mortality rates of replacement, and the patient's functional status after the replacement.

Studied population and methods

Patients who had undergone esophageal resection and reconstruction for benign disease by the authors over a 21-year period (1975 to 1996) were reviewed retrospectively. Patients in whom esophagectomy was performed for severe dysplasia were excluded from the analysis. The studied group consisted of 104 patients, 59 of whom were male and 45 of whom were female, ranging in age from 6 to 79 years with a median age of 44 years. Eighty-eight percent of patients had at least one prior esophageal operation with a median of two and a maximum of 12 operations. The most common previous procedure was an ineffective antireflux operation.

Dysphagia was the major symptom driving esophageal resection and replacement in 80% of patients. Other symptoms necessitating esophagectomy were repetitive aspiration (2%) and acute hemorrhage (1%). In the remaining patients, the procedure was performed to control acute or chronic sepsis (13%) or to reestablish gastrointestinal continuity after a previously failed reconstruction (4%). Most patients had a litany of additional symptoms, all of which were secondary to foregut dysfunction (Table I).

The functional status of the foregut was routinely evaluated before resection and reconstruction in an effort to determine the cause of the patient's driving symptom. Diagnostic modalities included video upper gastrointestinal barium contrast study, esophagogastroduodenoscopy, stationary and/or ambulatory esophageal manometry, 24-hour esophageal and/or gastric pH monitoring, and scintigraphic gastric emptying scans. On the basis of these studies, the patients were classified as to the underlying disease process causing functional failure of the foregut.

Two conditions were identified as being problematic to the surgeon treating end-stage esophageal diseases and require further comment. The first relates to the definition of esophageal body failure. In our patient population, propulsive failure was defined by the presence of 40% or more simultaneous waveforms in the distal two thirds of the esophagus associated with contraction amplitudes below the 5th percentile of normals ($<$25 mm Hg).[1] The second problematic area relates to the definition of an undilatable esophageal stricture. Our preference for esophageal dilatation in patients with advanced disease and a previous history of repetitive dilatations was to use the Eder-Puestow or Savary dilators (New Eder Corporation, Wood Dale, Ill.) under fluoroscopic control after the patient had been given a general anesthetic in the operating room. If the stricture was successfully dilated, the patient was instructed in the technique of home dilatation, and the response to dilatation was assessed. Esophageal function studies were performed when the response to dilatation was optimal. Patients with esophageal strictures were considered for esophageal resection and replacement when dilatation was not possible or, if possible, was unable to provide relief from dysphagia or the relief was short-lived. The latter was usually associated with esophageal body propulsive failure.

Colon was used initially to reconstruct the esophagus in 85 patients; stomach was used in 10 patients, and jejunum was used in 9 patients. In five patients undergoing reconstruction with colon, the esophagus was removed with a vagal sparing technique (Fig. 1). This was accomplished by dividing the esophagus in the neck and at the gastroesophageal junction in the abdomen, sparing the vagal nerves. The latter was achieved by performing a highly selective vagotomy along the proximal lesser curvature and dividing the stomach just below the gastroesophageal junction. The isolated esophagus was removed by passing a vein stripper up through the esophagus from the abdomen, securing it to the distal portion of the divided cervical esophagus, and invaginating the esophagus as it is pulled out through the esophageal hiatus.[2] The vagal nerves were sheared off as the muscular wall turned in during the invagination process. The remaining posterior mediastinal tunnel was progressively dilated with a 90 ml Foley catheter balloon to create an adequate passageway for the colon interposition graft. One patient in whom ischemic necrosis developed after a reverse colon interposition was referred for treatment with a blind remnant of the reversed colon anastomosed to the stomach. Her condition was managed by dividing the middle colic artery supplying

Table I. *Symptoms of end-stage esophageal disease (n = 104)*

Symptom	*Percent*
Dysphagia	90
Regurgitation	57
Heartburn	52
Weight loss	32
Chest pain	25
Epigastric pain	22
Vomiting	20
Coughing	18
Nausea	18
Choking	9
Voice change	7
Diarrhea	3
Odynophagia	2
Anorexia	1
Bloating	1

and tethering the blind segment, placing the blind segment substernally, reestablishing the blood supply by anastomosing the middle colic vessels to the left internal thoracic vessels, and restoring gastrointestinal continuity by an esophagocolonic anastomosis.

Of the 104 patients, seven required an additional procedure to achieve a good functional outcome. In five patients, the colon graft was tortuous and redundant, or there was delayed emptying of a retained, denervated stomach. The revision in these patients consisted of tailoring or resecting a segment of the colon graft, resecting the proximal stomach with reanastomosis of the antrum to the colon or, when length was insufficient, placing a jejunal interposition between the colon and the gastric antrum (Fig. 2). The sixth patient had an ischemic colon that was revised with a gastric pull-up; the seventh patient had an ischemic gastric pull-up that was revised with a free jejunal graft. Of the 104 patients undergoing esophageal replacement, 42 who had lived with their reconstruction for 1 year or more were contacted by telephone to answer a postoperative questionnaire. The questionnaire asked specifically about the time required after hospital discharge for the patient to achieve a full functional recovery, the patient's current ability to ingest a meal, annoyances the patient was presently experiencing related to alimentation, and the overall patient satisfaction with the outcome of their operation (Table II). The median follow-up was 26 months with a follow-up interval of 1 to 2 years for 20 patients, 2 to 4 years for 16 patients, and more than 4 years for 6 patients.

Results

Conditions leading to esophageal replacement. The benign diseases leading to esophageal replacement are listed in Table III. End-stage gastroesophageal reflux disease and advanced esophageal motility disorders were the most common underlying conditions. In some situations, the disease advanced despite appropriate medical or surgical therapy. In other situations, an inappropriate or poorly administered therapy contributed to the deterioration in esophageal function. Iatrogenic esophageal injuries occurred from endoscopic or surgical procedures on the esophagus or inadvertent injury to the esophagus by operation on adjacent organs. Examples of the latter were mediastinoscopy, coarctation repair, vagotomy, and spinal surgery.

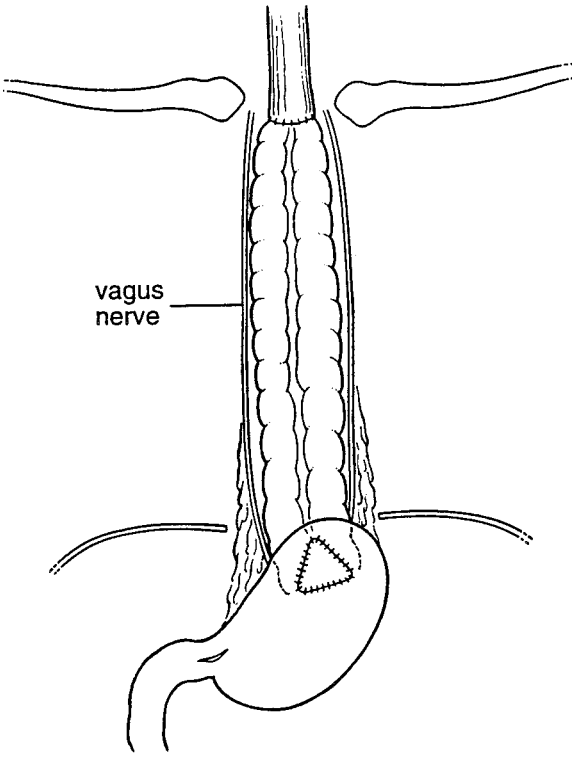

Fig. 1. Schematic drawing of a vagal sparing esophagectomy with colon interposition. This reconstruction appears to give the best postoperative function.

Effectiveness of esophageal replacement in relieving the primary symptom driving surgery. Ninety-eight percent of the patients judged that their operation had a positive effect on the primary symptom or condition driving the operation. Specifically, 73% of the patients were improved, and 25% of the patients were cured of their preoperative complaints by esophageal replacement. Ninety-three percent of the patients were satisfied with the overall outcome of the operation. Ninety-five percent of the patients stated that, if faced with the decision again, they would make the choice to undergo the procedure.

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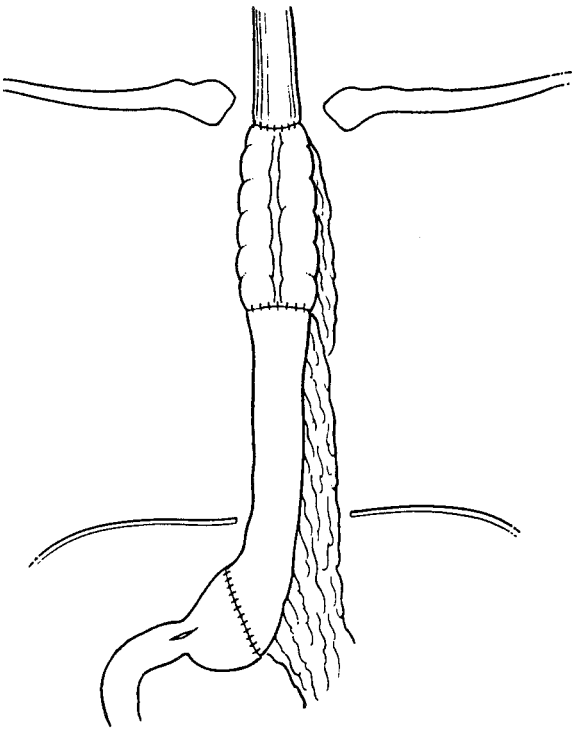

Fig. 2. Schematic drawing of a composite graft used to salvage patients who have an existing nonfunctional colon interposition. In most situations the size of the retained proximal colon was reduced by a coloplasty.

Table II. *Categories assessed by questionnaire*

Recovery	*Ingestion*	*Annoyances related to alimentation*	*Overall satisfaction*
Time to full recovery	Number of meals/day	Dumping	Relief of symptoms
	Meal capacity	Nausea	Outcome of surgery
	Diet restraints	Bloating	Risk/benefit assessment
	Last to finish	Frequent stools	
	Early satiety	Nocturnal regurgitation	
	Require liquids	Gurgling	
	Slow transit	Bad breath	
	Odynophagia		
	Choking		

Morbidity and mortality rates of esophageal replacement. Median hospital stay was 17 days, with a range of 7 to 216 days. Two patients died while in the hospital, resulting in a mortality rate of 2%. Both died of sepsis with multiple organ failure. Graft necrosis occurred in three patients (3%), two with colon interpositions and one with a gastric pull-up. One necrotic colon graft resulted in a hospital death; one necrotic colon graft was removed with subsequent reconstruction by the use of a gastric pull-up, and one ischemic gastric pull-up was removed and later replaced with a free jejunal interposition. A leak at one of the anastomotic sites occurred in six patients (6%), or 2% of anastomoses. The most commonly affected anastomosis was the esophagocolostomy (Table IV). Thirty percent of patients undergoing gastric pull-up required postoperative dilatation, although only 5% of patients with colon interposition did. Only one patient, with a gastric pull-up, experienced persistent dysphagia requiring intermittent dilatations.

Table III. *Benign esophageal conditions leading to replacement*

Diagnosis	*No. of patients*
End-stage GERD	37
Undilatable stricture	25
Other	12
Advanced motility disorder	37
Traumatic or iatrogenic injury or spontaneous perforation	15
Corrosive injury	8
Congenital abnormality	6
Extensive leiomyoma	1

GERD, Gastroesophageal reflux disease.

Functional status after esophageal replacement. From the perspective of the 42 patients who responded to the questionnaire, it took a median of 2 weeks after discharge to achieve full recovery, with a range of 1 to 96 weeks. Overall, 83% of patients reported enjoying three meals a day without difficulty, although only 15% and 2% were limited to two or one meals, respectively. Fifty-three percent of the patients had the capacity to eat a steak dinner at one sitting; 32% of the patients were limited to the size of a first-class airline meal and 15% to an airline snack (Table V). Sixty-nine percent of patients had the pleasure of an unrestricted diet. The process of ingestion was slower after esophageal replacement because 62% of the patients were the last to finish in a group meal. Minor inconveniences in the patient's ability to ingest were the requirement for liquid in 32% of the patients, a sensation of slow transit in 25% of the patients, and choking in 2% of the patients. The number of patients evaluated after a gastric pull-up or jejunal interposition was too

Table IV. *Anastomotic leaks after primary reconstruction**

Site	*Total (no.)*	*Leak (no.)*	*%*	*Postoperative day*	*Outcome*
Esophagocolonic	85	3	3.5	4, 12, 28	Healed conservatively Died (sepsis) Healed conservatively with stenosis, reanastomosed successfully at 27 mo.
Cologastric	84†	1	1.2	7	Healed conservatively
Esophagogastric	10	2	20	10, 11	Healed conservatively Healed conservatively

No leaks occurred in 84 colocolonic, 9 esophagojejunal, or 9 jejunogastric anastomoses.

*Seven patients underwent a subsequent remedial procedure, one of whom experienced the development of a leak at the anastomosis between a free jejunal graft and the stomach.

†One patient was referred after a failed colon interposition with an intact cologastric anastomosis.

small to justify a comparative analysis with colon interposition. Some patients gained and others lost weight after the operation. Overall the median change in weight was a gain of 10 pounds, with a range of −53 to +70 pounds.

Annoyances related to alimentation that occasionally occurs after esophageal replacement and reconstruction of the foregut are shown in Table VI. With the exception of gurgling and bad breath and for some patients nocturnal regurgitation, these complaints were present before surgery and persisted after reconstruction. The most bothersome was nocturnal regurgitation and was alleviated by elevation of the head of the bed. All annoyances tended to abate with time.

Discussion

The most common abnormalities leading to esophageal replacement are end-stage gastroesophageal reflux disease and advanced motility disorders. Of all the benign conditions potentially requiring esophageal replacement, these two are the most problematic in terms of the decision to abandon medical therapy or less extensive surgical therapy and proceed with esophagectomy. Because previous surgical therapy may have contributed to the problem, both patient and physician may be reluctant about further surgical intervention. Each additional non-extirpative procedure, however, such as a dilatation of a stricture, pneumatic dilatation for achalasia, fundoplication, or myotomy has the potential to cause further tissue damage with additional loss of function.

Similarly, each successive operative mobilization reduces the blood supply to the esophagus, with the possibility of ischemic necrosis, and puts the vagus nerves in jeopardy, with the possibility of altered foregut motility. Experience has taught us that a successful outcome after three previously failed operations about the lower esophageal sphincter is unlikely. The need for a fourth procedure is usually an indication for esophageal resection with replacement.

A subject of considerable controversy is the appropriate choice of an esophageal substitute. We have opted to use the colon, when of suitable quality, in the patient with benign disease who has a long life expectancy. Although the number of patients in our series who have undergone esophageal replacement with stomach or jejunum is too small to justify a meaningful comparative analysis of functional outcomes versus the colon interposition group, we based our decision to use colon in most of the patients on several important considerations.

A gastric advancement, when present for an extended time period, is prone to the development of several complications. Although technically easier to perform, the gastric advancement is frequently associated with symptoms from duodenogastric reflux and rapid gastric emptying in the upright position.[3] Most patients experience symptoms during or shortly after eating, the most common being a postprandial pressure sensation and early satiety, probably related to the loss of the gastric reservoir.

The late appearance of proximal esophagitis, stenosis, or Barrett's esophagus is common with an esophagogastric anastomosis made within the chest.[4] For this reason alone, an intrathoracic esophagogastrostomy should be abandoned. We virtually never perform an Ivor Lewis–type esophagectomy with an intrathoracic esophagogastrostomy. Although there is general acceptance of the concept that an esophagogastric anastomosis in the neck results in less postoperative esophagitis and stricture formation than one performed within the chest, reflux esophagitis after a cervical anastomosis does occur. Patients undergoing a cervical esophagogas-

Table V. *Comparison between types of interposition and ability to ingest*

	Percentage		
Assessment	*Colon (n = 31)*	*Stomach (n = 5)*	*Jejunum (n = 6)*
Able to take three meals/day	87	80	67
Able to eat steak dinner	58	40	33
Normal transit	81	60	50
Free of satiety	45	20	17

Table VI. *Annoyances related to alimentation that occasionally occur after esophageal replacement (n = 42)*

Complaints	*Percent*
Nausea	24
Bad breath	22
Nocturnal regurgitation	20
Bloating	20
Frequent stools	19
Dumping	13
Gurgling	4

trostomy for benign disease can experience problems associated with the anastomosis in year 4 or 5 after the operation. This may be severe enough to require anastomotic revision and is due to continued acid production by the stomach after a pull-up procedure, despite having been vagotomized.[5] As a result, the positioning of gastric epithelium in juxtaposition to squamous esophageal mucosa predisposes the patient to the development of esophagitis, stricture, or columnar metaplasia within the esophageal remnant. A recent series from Japan revealed reflux esophagitis in 44% of patients and Barrett's metaplasia in 12% of patients, followed more than 2 years after a cervical esophagogastrostomy.[6] In contrast, the esophageal mucosa in patients with colonic interpositions appears to undergo little if any histologic changes.[7]

Orringer and Stirling[8] have reported on 87 patients who underwent esophageal replacement by use of the stomach for benign diseases. Fifty-four of the patients (67%) required immediate postoperative dilatation and 13 of them (15%) had persistent dysphagia requiring home dilatation.

Similarly, we had a 30% incidence of postoperative dilatations after esophagogastrostomy. This early postoperative stricturing may well relate to ischemia of the stomach at the site of anastomosis. In comparison, only 5% of our patients with a esophagocolonic anastomosis required immediate dilatation, and none had persistent dysphagia requiring home dilatation.

We acknowledge that complications may also develop in colonic interpositions, although we believe that, with meticulous attention to operative detail, the incidence if such problems occur can be minimized. Six of our patients initially undergoing a colon interposition had to undergo a subsequent revision, the majority for graft redundancy or delayed emptying secondary to a retained, denervated stomach. As experience was gained and these complications were recognized, modifications in our surgical technique were made to circumvent such problems. We now are diligent about removing all redundancy and tortuosity from the colonic graft before performing the cologastric anastomosis. Because many of the problems ascribed to colon interposition are merely the results of poor gastric emptying, we now perform a two-thirds proximal gastrectomy whenever a colon is interposed to a denervated stomach. The remaining distal third of the stomach is anastomosed end to end to the colon graft. This gives a better result in that the colonic interposition functions as a contracting reservoir for the retained antrum, which continues with its own innate contractions at 3 cycles per minute, thereby maintaining its pump function.

The most common symptom after esophageal replacement with an interposed colon is the sensation of fullness or pressure after meals. This complaint is more prone to occur early after surgery and is exaggerated by over-ingestion of food.

This reflects the limited reservoir capacity of the colon and the fact that further stretch is not tolerated without discomfort. The complaint is less likely to occur if the colon is anastomosed to an innervated and intact stomach, as occurs with a vagal sparing esophagectomy.

Fullness after meals is often interpreted incorrectly as dysphagia. True dysphagia, however, is uncommon after colon interposition and, when it occurs, is usually due to an anastomotic stricture or redundancy of the graft. Over time, the amount of food that can be ingested at one sitting by a patient with a colon interposition increases, such that a socially acceptable meal can be enjoyed without discomfort. A key benefit of the colon is that the longer it is interposed, the better it seems to function and the more satisfied the patient becomes. Consequently, for patients with benign disease we

prefer a colon interposition to obviate the late problems associated with esophagogastrostomy.

In our experience, the most satisfactory esophageal replacement is achieved when a vagal sparing esophagectomy can be performed. Many of the annoyances that occur after esophageal replacement are due to the concomitant vagotomy and the loss of parasympathetic modulation of foregut function. By sparing the vagus nerves, the colon is anastomosed to a fully innervated stomach and distal gastrointestinal tract. Of course, this procedure is only applicable when the vagi have not been previously compromised and the patient does not otherwise have gastroparesis. Patients with achalasia, who have enlarged blood vessels supplying their esophagus, or those who have scarring from previous esophageal or mediastinal surgery require a thoracotomy to mobilize the intrathoracic esophagus along with the vagal plexus on its surface before its stripping.

We have experience with vagal-sparing esophagectomy and colon interposition in several recent patients. On the basis of our early experience with the procedure and its theoretic advantages, we believe it to be the operation of choice for esophageal reconstruction when it can be technically accomplished, the patient is physiologically fit, and long-term esophageal function is sought.

In summary, our preferred method of esophageal replacement after esophagectomy for benign disease, in patients fit to undergo such a procedure, is a vagal sparing esophagectomy with colon interposition, the colon being anastomosed to the intact stomach. If the vagus nerves have been previously compromised or cannot be preserved, a proximal two-thirds gastrectomy is performed. If the colon is unsuitable as an esophageal substitute or the patient is elderly or infirm, the stomach is used. Only if both of these organs are unsuitable or unavailable would consideration be given to the use of the jejunum, either as a transposition or as a free graft.

Summary

The observation that esophageal resection and reconstruction for benign disease can be performed with only a 2% mortality rate, minimal morbidity, and a 98% incidence of improvement in the main symptoms driving surgery is encouraging news to patients who are crippled from the various manifestations of advanced esophageal disease. Patients referred to our center for esophageal reconstruction had universally had unsuccessful attempts at more conservative approaches elsewhere, a fact that further supports the decision to proceed with resection in cases of advanced benign disease. The continuation of slow, anxious, and socially restricted alimentation or the maintenance of nutrition by enteral or parenteral means is unnecessary. The patient should be referred to a unit skilled in evaluating foregut function, performing esophageal replacement surgery, and caring for patients in the perioperative period. In our experience, the colon, when available, is the preferred conduit for esophageal replacement over the long term. Esophageal replacement, however, does not restore alimentation to the level experienced by an individual with a normal esophagus. Despite the fact that some subtle preoperative symptoms of foregut dysfunction may persist after surgery, the overall outcome is judged to be satisfactory. Indeed, patients can reenter society and live a normal and fulfilled life after remedial surgery. Esophageal reconstruction restores the pleasure of eating and dramatically improves the quality of life for patients with end-stage, benign esophageal disease.

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Discussion

Dr. Alex G. Little *(Las Vegas, Nev.).* There is a folk aphorism, "If it ain't broke, don't fix it"; but the corollary is that, if it is broke, you should fix it. You cannot repair it simply by changing from one broken entity to another;

and, despite the instinct to salvage the esophagus, it is not going to function if the patient is not going to be able to use it even if it is still there. It is better off being replaced. I would suggest that is the important global message of this paper.

Just a few questions. First, focusing on the patients with reflux who make up the predominant population, could you make any statements about the cause of failure of the first operation? Was it typically a failure actually of diagnosis so that people are having inappropriate operations or were there technical errors? If so, could you pinpoint the most common errors so that we can get to prevention of reoperations rather than technique?

Dr. Watson. The majority of patients who were referred to us with failures after antireflux surgery had experienced this failure because of technical problems. The most common type of problem was slippage of the wrap about the proximal stomach rather than about the distal esophagus; the second most common problem was herniation of the wrap up into the chest. We have found that many of these people had a short esophagus, and we think that may have been the cause.

Dr. Little. Do you think closure of the hiatus was commonly done initially? That is, one of the things I see from time to time is patients who seem to have had a reasonably well-constructed wrap, but nobody bothered to close the hiatus.

Dr. Watson. I cannot comment on that with exact numbers. Again, I would say that the short esophagus was a problem, and it was not recognized.

Dr. Little. My second question related to reflux has to do with patients who are being reoperated on. Can you make a decision about resection versus a redo antireflux procedure before surgery, or is that a decision that is made during the operation? My own experience would be that occasionally, at least, it is necessary to make that decision intraoperatively. What operative approach do you choose when you are reoperating? I tend to prefer the thoracic approach because it leaves all the options open, both reconstruction and resection. An abdominal or even laparoscopic approach can result in a situation that limits the surgeon.

Dr. Watson. Whether we make the decision to redo an antireflux procedure or to resect the esophagus depends on several factors. First of all, it depends on the underlying status of the esophageal body; if the esophageal body has demonstrated propulsive failure and we believe that an antireflux operation is likely not to correct any underlying dysphagia, then that would certainly be an indication to proceed with resection. We have also followed the rule that, if a person has had three previously failed antireflux operations, further attempts are unwarranted and we would consider esophageal replacement.

Our approach to redo antireflux surgery has been through a left transthoracic approach. This allows us to approach the hiatus through virgin tissues. It allows us to fully mobilize the esophagus, especially when esophageal length is a problem, and allows us to more easily perform an esophageal lengthening procedure if that is necessary. On occasion, though, the decision is made intraoperatively, because of damage to the tissues with repeat dissection, that an esophageal resection will be necessary.

Dr. Little. My final question has to do with the choice of replacement organ; I am a bit struck by your enthusiasm for the long-segment colon interposition. I am sure you are aware that has not been a universal experience. For example, at the University of Chicago, a review of a large number of these patients documented that up to one third of them needed some type of reoperation related directly to the colon itself. Therefore many of us have gone to a more selective approach where the colon is preferred for what you might call a short segment interposition, that is, two thirds of the esophagus is still anatomically and functionally available. Then you can do something through the left side of the chest with a short segment colon or even jejunum that is a reasonable procedure. In contrast I and others have found better functional results from stomach, tubed stomach, when reconstruction is in the neck. I guess I am asking if you think your experience is unique or will be able to be duplicated. In other words, I am concerned about routine use of the colon for anastomosis in the neck.

Dr. Watson. A colon interposition is certainly a more technically demanding operation than are gastric pull-ups. We believe that, especially with the availability of vagal sparing transhiatal techniques, a long-segment colon gives the best long-term outcome. It also avoids some of the problems associated with an intrathoracic anastomosis, as you are all aware, such as leakage and reflux through that segment. We can also avoid a thoracotomy in many patients, so our choice has been to use long segments of colon for a variety of theoretic reasons. I do think that, with proper attention to detail, our results can be duplicated.

Dr. Claude Deschamps *(Rochester, Minn.).* Are you concerned when you hook the colon on a little pouch of distal stomach that you are going to get reflux, and did you or your group consider doing a Roux-en-Y in those patients instead of hooking to the distal antrum?

We also looked at our group of long-term survivors of esophageal cancer, and we found that the minority of the patients were asymptomatic, just like in your patients. Did you look at dumping symptoms in those patients and how they need medication in the long term?

Dr. Watson. Let me answer your second question first. Yes, our questionnaire did concentrate on dumping symptoms. Many of the symptoms that patients experience after an esophagectomy we believe are actually related to the concomitant vagotomy and the alteration in gastrointestinal function that result; so our questionnaire did focus on dumping, diarrhea, bloating, and such, and that is reflected in our data.

With regard to your first question about anastomosing the colon to the antrum, we believe that because of the intraabdominal position of the antrum, reflux is not a problem because the antrum is exposed to the positive-pressure environment of the abdomen as is the distal colonic segment. We think that forms somewhat of an antireflux barricade. We have performed, for other indications, a colon graft to a Roux-en-Y segment in the patient in whom the antrum had been previously resected. We do worry in that situation, though, about Roux-stasis syndrome and resultant dysphagia.

Dr. Walter B. Cannon *(Palo Alto, Calif.).* Do you think you have to resect the esophagus every time? There are certainly situations where the esophagus is going to be firmly adherent to the surrounding tissue, which might lead to a rather difficult operation and perhaps unnecessary operation. Do you think that the esophagus should be resected every time with these problems?

Dr. Watson. As compared to doing a bypass procedure?

Dr. Cannon. That's right.

Dr. Watson. The only indication for which we have left the native esophagus intact has been corrosive injuries, where there has been a large amount of fibrosis within the posterior mediastinum; I think that in such a situation, it is reasonable to leave the native esophagus intact. There is a theoretic concern for carcinoma appearing in the segment later, and the inability to access it for diagnosis; but I do believe that would be rare.

Dr. John R. Benfield *(Sacramento, Calif.).* I have some quarrel with the use of the word *benign*. The noncancerous conditions you treated are anything but benign. Moreover, those of us who have particular interest in cancer know that there are certain cancers that really have a rather benign behavior. Thus I think your paper would have been just perfect had you deleted the word *benign* from the title and simply called it end-stage esophageal disease.

In my experience with making anastomoses in the neck, be it the stomach or the colon that is brought up, I have found that the tight thoracic inlet is probably the single most important factor that places the anastomoses at risk. We have not actually tabulated this, but my best estimate would be that, at least 30% of the time, I end up resecting some of the manubrium or some portion of the clavicle in the thoracic inlet to be sure that there is no constriction. I wonder if your experience has been similar.

Dr. Watson. First of all with your comments about benign disease, I am in absolute agreement that many of these conditions are not benign as I showed in my slides from Wales and Finland. So-called benign diseases have certainly led to deaths, especially now with the increasing prevalence of esophageal adenocarcinoma of which gastroesophageal reflux and Barrett's are the only known risk factors; it is certainly hard to consider that ongoing reflux is completely a benign disease.

With regard to your question about the thoracic inlet, we routinely resect the left hemimanubrium, head of the first rib, and head of the clavicle when we bring up our transposed organ in a substernal position, because we find that, when they are substernal, those bony structures do impede passage of food bolus. When we bring the organ up through the posterior mediastinum, we have found that to be less of a problem and have not had to resect those bony structures in those circumstances. But again, we do it routinely for the substernal route.